



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 069 573
A1

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 82303516.7

(51) Int. Cl.³: A 01 N 25/04

(22) Date of filing: 05.07.82

A 01 N 47/40, D 21 C 9/00

(30) Priority: 06.07.81 US 280567

(43) Date of publication of application:
12.01.83 Bulletin 83/2

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

(71) Applicant: MERCK & CO. INC.
126, East Lincoln Avenue P.O. Box 2000
Rahway, New Jersey 07065(US)

(72) Inventor: Weber, George A.
151 Fulton Street Clark
New Jersey 07066(US)

(72) Inventor: Pettebone, Russel H.
31 Poplar Place
Fanwood New Jersey 07023(US)

(72) Inventor: D'Errico, Michael J.
3018 Herald Crescent
Flossmoor Illinois 60422(US)

(74) Representative: Crampton, Keith John Allen et al,
D YOUNG & CO 10 Staple Inn
London WC1V 7RD(GB)

(54) Improved aqueous dispersion microbiocide composition containing methylene bis(thiocyanate).

(57) A microbiocidal composition in the form of a stable, pumpable aqueous dispersion contains methylene bis(thiocyanate) dispersed in an aqueous composition containing from 0.75 to 3.0% by weight of a copolyampholyte, in the form of a self-inverting emulsion, comprising polymer units resulting from dimethyldiallylammonium X[⊖], diethyldiallylammonium X[⊖], acrylamide and optionally acrylate; and from 5.0 to 15.0% by weight of a suspension-improving and viscosity-improving inorganic substance in the form of colloidal fine particles. The composition is used as a microbiocide primarily in paper mills and cooling towers to inhibit the growth of slime-forming bacteria and fungi usually encountered in pulp and paper mill systems, but can be used more generally for treating water contaminated with microbes.

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IMPROVED AQUEOUS DISPERSION MICROBIOCIDIC
COMPOSITION CONTAINING METHYLENE BIS(THIOCYANATE)

The present invention is concerned with aqueous dispersion microbiocide compositions containing methylene bis(thiocyanate),
5 also called MBT.

Methylene bis(thiocyanate) has been for some time and continues to be a widely used antimicrobial agent. It has a broad spectrum of activity against bacteria and fungi and has been found to be extremely effective at low cost levels.
10 As a consequence, it is especially useful as an agent for controlling slime-producing organisms in pulp and paper mill systems and in cooling water systems.

Hitherto, the antimicrobial agent methylene bis(thiocyanate) has been made up and applied essentially in the form of an
15 organic solvent solution. Problems of toxicity and environmental contamination and other problems resulting from the use of such organic solvents has led to a search for a satisfactory aqueous dispersion of methylene bis(thiocyanate). Such an aqueous dispersion must be stable, that
20 is, the methylene bis(thiocyanate) must not settle out of the dispersion. Also, it is preferable to have an aqueous dispersion which can be handled by pumping equipment which is frequently employed without degradation of the aqueous dispersion.

Such an aqueous dispersion of methylene bis(thiocyanate)
25 is described in U.S. Patent No 3,996,378, which discloses a water-based formulation of methylene bis(thiocyanate) in a xanthan gel. However, this dispersion has been found to lack sustained stability, and on standing has been found difficult to pump without preliminary agitation.

30 Parran U.S. Patent No 3,761,417 describes detergent compositions containing particle deposition enhancing agents in which antimicrobial agents and certain cationic polymers are combined with a surfactant. However, methylene bis-(thiocyanate) is not described as a suitable antimicrobial
35 agent for use in the detergent composition, and the improved



aqueous dispersion composition containing methylene bis-(thiocyanate) of the present invention is not described or suggested in this patent.

The present invention provides a microbiocide composition comprising methylene bis(thiocyanate) dispersed in an aqueous composition containing from 0.75 to 3.0% by weight of a copolyampholyte, in the form of a self-inverting emulsion, comprising polymer units resulting from dimethyldiallylammonium X^{\ominus} , diethyldiallylammonium X^{\ominus} , acrylamide and optionally acrylate; and from 5.0 to 15.0% by weight of a suspension-improving and viscosity-improving inorganic substance in the form of colloiddally fine particles.

Also in accordance with the present invention water contaminated with microbes, that is, bacteria, fungi and/or algae, is treated by incorporating in it at least a microbiocidal amount of a microbiocidal aqueous dispersion composition of the present invention. This method is especially applicable to inhibiting the growth of slime-forming bacteria and fungi usually encountered in pulp and paper mill systems by bringing such bacteria or fungi into contact with at least a microbiocidal amount of the composition of the present invention, particularly by incorporating the microbiocidal composition into the mass of fiber and water in such a pulp and paper mill system.

The present invention, in contra distinction in particular to US Patent No 3,996,378, achieves an aqueous dispersion of methylene bis(thiocyanate) through the use of a particular copolyampholyte in the form of a self-inverting emulsion, and a suspension-improving and viscosity-improving inorganic substance in the form of colloiddally fine particles. These ingredients have been found to provide a stable aqueous dispersion, that is, one from which the methylene bis(thiocyanate) does not settle. This stable aqueous dispersion composition is also readily pumpable. A number of other polymeric compositions have been evaluated, for example, carboxymethyl cellulose, hydroxyethyl cellulose, and polyvinyl alcohol, but none of these has a given



stable aqueous dispersion of methylene bis(thiocyanate).

The stable aqueous dispersion microbiocide composition containing methylene bis(thiocyanate) achieved with the present invention thus offers particular advantages in the areas of preferred use. The use of an aqueous dispersion overcomes the disadvantages inherent in the use of organic solvents to dispense the methylene bis(thiocyanate), that is, these organic solvents are both toxic and flammable. The stability of the aqueous dispersion of the present invention ensures that the methylene bis(thiocyanate) will be dispensed efficiently, that is, in effective but economic amounts, and that there will be no settling out of particles which can create



blockages in the dispensing apparatus. The aqueous dispersion microbiocide composition of the present invention also offers the important advantage of being readily pumpable, that is, it can be
5 transported and dispensed by commonly employed pumping means without experiencing problems such as excessive viscosity, either during pumping or initially after standing, which would require that the dispersion be agitated before pumping could take
10 place.

Since the present invention concerns an aqueous dispersion microbiocide composition containing methylene bis(thiocyanate), a water-insoluble material, it will be appreciated that
15 the particle size distribution of the methylene bis(thiocyanate) is of some importance. Generally, at least 99.0% of the particles should be less than 75 micrometers (μm) in size, with no more than 0.1% of the total particles greater than 150 μm in size.
20 In a preferred embodiment, the methylene bis(thiocyanate) is reduced in a homogenizer and the wet particles are screened so that a maximum of 0.1% is collected on a 100 mesh screen (U.S. Standard Testing Sieves), while a minimum of 99.0% passes
25 through a 200 mesh screen. This corresponds to a particle size of greater than 150 μm for the 100 mesh screen, and less than 75 μm for the 200 mesh screen. In another preferred embodiment, the methylene

30



bis(thiocyanate) is reduced in a colloid mill. The particle size distribution for three batches processed through such a colloid mill, were found to be as follows:

5

Sieve Size:	On 100 mesh	On 200 mesh	Through 200 mesh
μ m Size:	> 150	> 75	\leq 75
Specification:	max. 0.1%	-	min. 99.0%

10	Batch No.			
	1	0.01%	1.10%	98.89%
	2	0.01%	0.75%	99.24%
	3	trace	0.16%	99.84%

15

Various means can be employed to achieve the desired particle size range. For example, various colloid mills and homogenizers which are commonly available may be employed. Satisfactory results have been achieved using a Tekmar Super Dispax, SD 45N homogenizer at high speed for three minutes, as well as a Speco Colloid Mill.

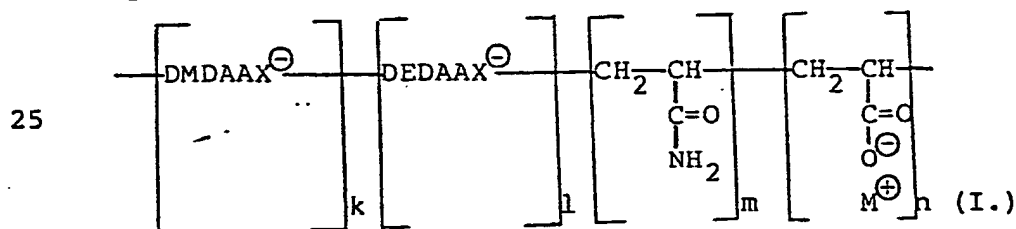
In the improved aqueous dispersion microbiocide composition of the present invention the particles of methylene bis(thiocyanate) are dispersed in an aqueous composition containing two components, the first of which is a copolyampholyte in the form of a self-inverting emulsion. The methylene bis(thiocyanate) is incorporated in an amount of from 5.0 to 25.0% by weight, based on the total weight of the aqueous dispersion. The upper limit of the amount of methylene bis(thiocyanate) which may be incorporated is determined essentially only by the



amount which it is physically possible to incorporate into the aqueous dispersion composition consistent with maintaining stability of the dispersion. The lower limit of the amount of methylene bis(thiocyanate) which may be incorporated is determined by the economic practicalities involved in marketing a composition of very low active ingredient concentration. A preferred concentration of methylene bis(thiocyanate) in the aqueous dispersion microbiocide composition of the present invention is 10% by weight, based on the total weight of the composition.

The copolyampholyte self-inverting emulsion is incorporated in an amount of from 0.75 to 3.0% by weight, based on the total weight of the aqueous dispersion. It has been found that amounts below 0.75% do not give a stable dispersion, while amounts above 3.0% result in a dispersion which is too viscous.

The copolyampholyte employed in the improved aqueous dispersion of the present invention may be represented by the following general formula:



where

DMAAX^{\ominus} is a polymer unit resulting from monomeric dimethyldiallylammonium X^{\ominus} ;

DEDAAX^{\ominus} is a polymer unit resulting from monomeric diethyldiallylammonium X^{\ominus} ;

X^{\ominus} is an anion;

M^{\oplus} is hydrogen; ammonium; sodium; or potassium;

k and l are numbers such that the amount of $DMDAAX^{\ominus}$ is from 45 to 48 weight % and the amount of $DEDAAX^{\ominus}$ is from 2 to 5 weight %, the said amounts together totalling 50 weight %; and

m and n are numbers such that the amount of $-CH_2-\overset{|}{CH}-CO-NH_2$ is from 45 to 50 weight % and the amount of $-CH_2-\overset{|}{CH}-COOM$ is from 0 to 5 weight %, the said amounts totalling 50%, the copolyampholyte having a molecular weight greater than 1×10^6 .

Any anion (counterion) compatible with microbiocidal use may be employed, and chloride is preferred. Other suitable anions include acetate, citrate, formate, glycolate, lactate, nitrate, oxalate, propionate, sulfate, and other halides, for example.

Preferred polymer compositions of Formula I are those in which X^{\ominus} is chloro, the amount of $DMDAAX$ is 47.5 weight %, the amount of $DEDAAX$ is 2.5 weight %; and the amount of $-CH_2-\overset{|}{CH}CONH_2$ is 47.64 weight % and the amount of $-CH_2-\overset{|}{CH}-COOM$ is 2.36 weight %, giving a copolyampholyte having repeating units of dimethyldiallylammonium chloride ($DMDAAC$), diethyldiallylammonium chloride ($DEDAAC$), acrylamide (AM), and acrylic acid (AA), or the amount of $-CH_2-\overset{|}{CH}CONH_2$ is 50 weight %, giving a copolyampholyte having repeating units of dimethyldiallylammonium chloride ($DMDAAC$).

diethyldiallylammonium chloride (DEDAAC), and acrylamide (AM). These preferred polymer compositions may be illustrated as follows, with proportions as parts by weight:

5	(1)	DMDAAC	/	DEDAAC	/	AM	/	AA
		190		10		191		9
	(2)	DMDAAC	/	DEDAAC	/	AM		
		190		10		200		

10 Preparation of these copolyampholytes, particularly in the form of self-inverting emulsions, is described in U.S. Pat. Nos. 4,077,930 and 4,147,681.

15 The second component used to disperse the methylene bis(thiocyanate) in order to form the improved aqueous dispersion microbiocide composition of the present invention is a suspension and viscosity improving inorganic substance in the form of colloiddally fine particles. Suitable materials are clays, such as colloidal attapulgite clay and
20 kaolin clay, and silica. A preferred inorganic substance is colloidal attapulgite clay, for example, X-1925 clay from Engelhard Industries. The suspension and viscosity improving inorganic substance is incorporated in an amount of 5.0 to
25 15.0% by weight, based on the total weight of the aqueous dispersion.

In addition to the methylene-bis(thiocyanate) active ingredient, self-inverting

emulsion of copolyampholyte and inorganic substance in the form of colloiddally fine particles, the aqueous dispersion microbiocide composition of the present invention also contains a number of

5 additional ingredients or excipients which are useful in producing a final aqueous dispersion microbiocide composition having the desired properties of viscosity, freeze/thaw stability, pH, lack of foaming, and ease of addition to water systems.

10 These additional ingredients or excipients are:

(1) 0.1 to 1.0% by weight of a wetting agent. A preferred material is Triton X-100 available from Rohm & Haas. The wetting agent is a processing aid employed to facilitate initial dispersion of

15 the methylene bis(thiocyanate) particles in water, which is the first step of preparing the aqueous dispersion microbiocide composition of the present invention.

(2) 0.1 to 1.0% by weight of a defoaming agent. A preferred material is Colloid 691 from Colloids, Inc. The defoaming agent prevents excessive foaming of the wetting agent during processing, and also when the aqueous dispersion microbiocide composition is added to an agitated water system,

20 for example, that in a pulp and paper mill system.

(3) 2.0 to 5.0% by weight of a freeze/thaw stabilizing agent, such as propylene glycol; and

(4) sufficient acid to give a final pH in the aqueous dispersion microbiocide composition of from 2.0

25 to 3.0. Any acid compatible with the overall aqueous dispersion microbiocide composition and with the end treatment environment may be used.

30

Organic acids are preferred, especially acetic acid and formic acid. The acid functions to lend stability to the methylene bis(thiacynate), which may tend to hydrolyze at alkaline pH's.

5 The carrier for the aqueous dispersion microbiocide composition of the present invention is, of course, water, and this is present in an amount of from 50.0 to 87.0%, preferably 70.0 to 80.0% by weight.

10 The improved aqueous dispersion microbiocide composition of the present invention will inhibit the growth of bacteria and fungi in concentrations of 9 to 90 ppm. It is particularly useful at these concentrations for inhibiting the growth of slime-forming bacteria and fungi usually encountered in pulp and paper mill systems and cooling water systems. For example, the aqueous
15 dispersion microbiocide composition can be added to the paper mill white water or stock system at 1.09 to 10.9 fl oz. per 100 gal. (8.5 to 85 ppm by volume) of treated water. Under conditions of extensive recirculation of white water, high levels of fillers in the furnish, and/or generally severe levels of
20 potential slime-forming bacteria and fungi, dosages approaching 10.9 fl. oz./1000 gal. (85 ppm v/v) of treated water may be necessary. Under less severe conditions, lower dosages approaching 1.09 fl. oz./1000 gal. (8.5 ppm v/v) of treated water can be used.

25 Where the improved aqueous dispersion microbiocide composition of the present invention is employed to inhibit the growth of slime-forming bacteria and fungi usually encountered in pulp and paper mill systems, it is metered directly, by means

of proportioning pumps, to a location which will ensure its uniform distribution in the mass of fiber and water, for example to the beaters, Jordan inlet, broke chests, furnish chests, save-alls, or white
5 water tanks. Metering of the improved aqueous dispersion microbiocide composition may be on a continuous or intermittent basis, provided that the recommended dosing is attained. Where metering is
10 intermittent, the use of automatic timers is recommended.

The following examples will serve to illustrate preparation of preferred embodiments of the improved aqueous dispersion microbiocide composition of the present invention, without,
15 however, being intended as a limitation thereof in any way.

EXAMPLE 1

<u>Ingredient</u>	<u>Amount</u> <u>% by weight</u>
Water	72.9
Wetting agent (Triton X-100; Rohm & Haas)	0.4
Defoamer (Colloid 691; Colloids, Inc.)	0.25
Methylene bis(thiocyanate) (Mybex, Calgon Corp.)	10.2*
Colloidal attapulgite clay (X-1925; Engelhard Industries)	10.0
Propylene glycol	3.75
Formic acid (88% active)	0.5
Copolyampholyte: DMDAAC/DEDAAC/AM/AA (Hydraid 5504; Calgon Corp.)	2.0

* Charge wet based on assay and reduce water charge accordingly.

The water is first charged to a vessel, after which there is charged and dispersed with moderate agitation, in sequence: the wetting agent and defoamer. There is then slowly charged the
5 methylene bis(thiocyanate) and mixed until well dispersed. The methylene bis(thiocyanate) in suspension is milled for three minutes at high speed with a Tekmar Super Dispax SD-45 homogenizer until the wet mesh particle size meets the following
10 specifications: max. 0.1% on No. 100; min. 99.0% passes No. 200. With moderate agitation there is then charged and dispersed in sequence: the clay, propylene glycol, and formic acid. Finally, there is slowly charged the copolyampholyte and agitation is
15 continued until a uniformly smooth dispersion is maintained.

An accelerated storage stability study of an improved aqueous dispersion microbiocide composition of the present invention prepared in the manner
20 described in the above example was carried out by maintaining the composition at 50°C for one month. At the end of that period, there was only a 3% drop in concentration of methylene bis(thiocyanate), and no separation or other physical change was observed.

25

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EXAMPLE 2

<u>Ingredient</u>	<u>Amount</u> <u>% by weight</u>
Water	73.2
Wetting agent (Triton X-100; Rohm & Haas)	0.4
Defoamer (Colloid 691; Colloids, Inc.)	0.25
Methylene bis(thiocyanate) (Mybex, Calgon, Corp.)	10.2*
Colloidal attapulgite clay (X-1925, Engelhard Industries)	10.0
Propylene glycol	3.75
Glacial acetic acid	0.5
Copolyampholyte: DMDAAC/DEDAAC/AM/AA Hydraid 5504; Calgon Corp.)	1.7

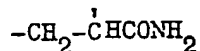
*charge wet based on assay and reduce water charge accordingly.

The aqueous dispersion microbiocide composition is prepared in accordance with the procedures described in Example 1 above, except that (1) the colloidal attapulgite clay is added to the mixture before milling to reduce particle size, and (2) milling is carried out on a Speco Colloid Mill.

3 A dispersion as claimed in claim 1 or 2 in which the amount of methylene bis(thiocyanate) is 10.0% by weight.

4 A dispersion as claimed in any one of claims 1 to 3 in which X^- is chloro, the amount of DMDAAX is 47.5 weight %, the amount of DEDAAX is 2.5 weight %, the amount of $-\text{CH}_2-\overset{\text{H}}{\underset{|}{\text{C}}}-\text{CONH}_2$ is 47.64 weight % and the amount of $-\text{CH}_2-\overset{|}{\text{CH}}-\text{COOM}$ is 2.36 weight %.

5 A dispersion as claimed in any one of claims 1 to 3 in which X^- and the amounts of DMDAAX and DEDAAX are as defined in claim 4 and the amount of



is 50 weight %.

6 A method of treating water contaminated with bacteria, fungi and/or algae, comprising incorporating in it at least a microbiocidal amount of a dispersion as claimed in any one of claims 1 to 5.

7 A method of inhibiting the growth of slime-forming bacteria and fungi usually encountered in pulp and paper mill systems, comprising incorporating into the mass of fiber and water in such a pulp and paper mill system so that it comes into contact with the bacteria and fungi, at least a bactericidally and fungicidally effective amount of a dispersion as claimed in any one of claims 1 to 5.



European Patent
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EUROPEAN SEARCH REPORT

0069573

Application number

EP 82 30 3516

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
D,Y	US-A-3 996 378 (J.H. PAYTON) * Claims *	1,3,6	A 01 N 25/04 A 01 N 47/40 D 21 C 9/00
D,Y	US-A-4 147 681 (S.K. LIM et al.) * Column 1, line 25 - column 2, line 3; examples 1-12, 30-33, 37,38,41,42,47; table VI; column 14, line 58 - column 15, line 32; column 16, line 64 - column 17, line 16 *	1,4,5	
Y	GB-A-1 157 883 (SUMITOMO) * Page 4, lines 44-102; claims *	1-3,6 7	
A	GB-A-1 321 404 (CHEMED) * Page 1, line 81 - page 2, line 48; page 2, line 101 - page 3, line 11; claims *	1,3,6 7	TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
A	CHEMICAL ABSTRACTS, vol. 95, no. 11, 14th September 1981, page 188, no. 92347f, Columbus, Ohio, USA & JP - A - 81 53602 (CHIYODA KAGAKU KENKYUSHO) 13-05-1981 * Abstract *	1,6	A 01 N D 21 C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 22-10-1982	Examiner FLETCHER A.S.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	